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The western Kenya insecticide-treated bed net trial

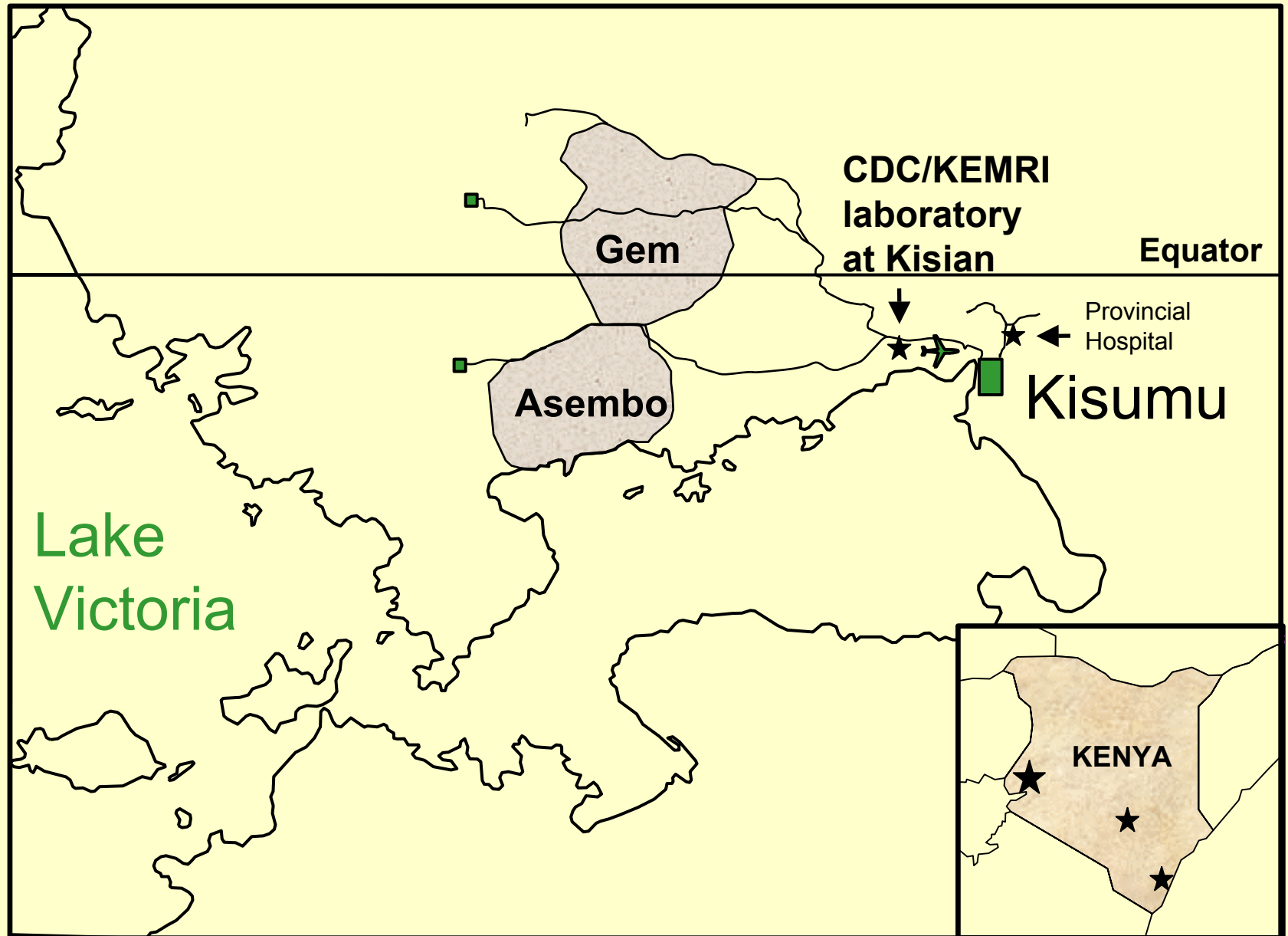
Supplement to
THE AMERICAN JOURNAL OF
TROPICAL MEDICINE AND HYGIENE



Main objectives

- Impact on mortality
- Impact on morbidity
- Impact on mosquito populations.
- Assess effects of scale and coverage on mosquito populations and human morbidity and mortality

CDC/KEMRI Field Station Western Kenya



Aerial View of KEMRI/CDC - Computer Center and Admin Bldgs.



12/2/1999

Gem –Clusters of Houses form Compounds



21/4/1999

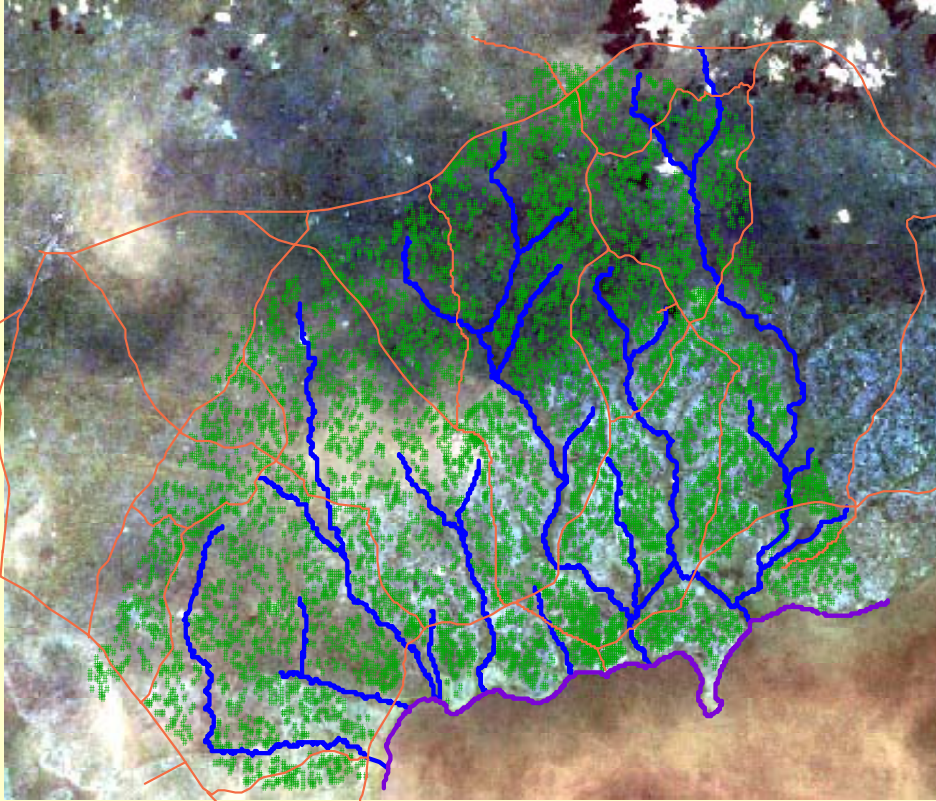


8/12/1998

The Shore was mapped by rowing a constant distance from the shore



GPS data (Compounds, Roads, Rivers, Shoreline) overlaid upon Satellite Image of Asembo Bay



A Typical House







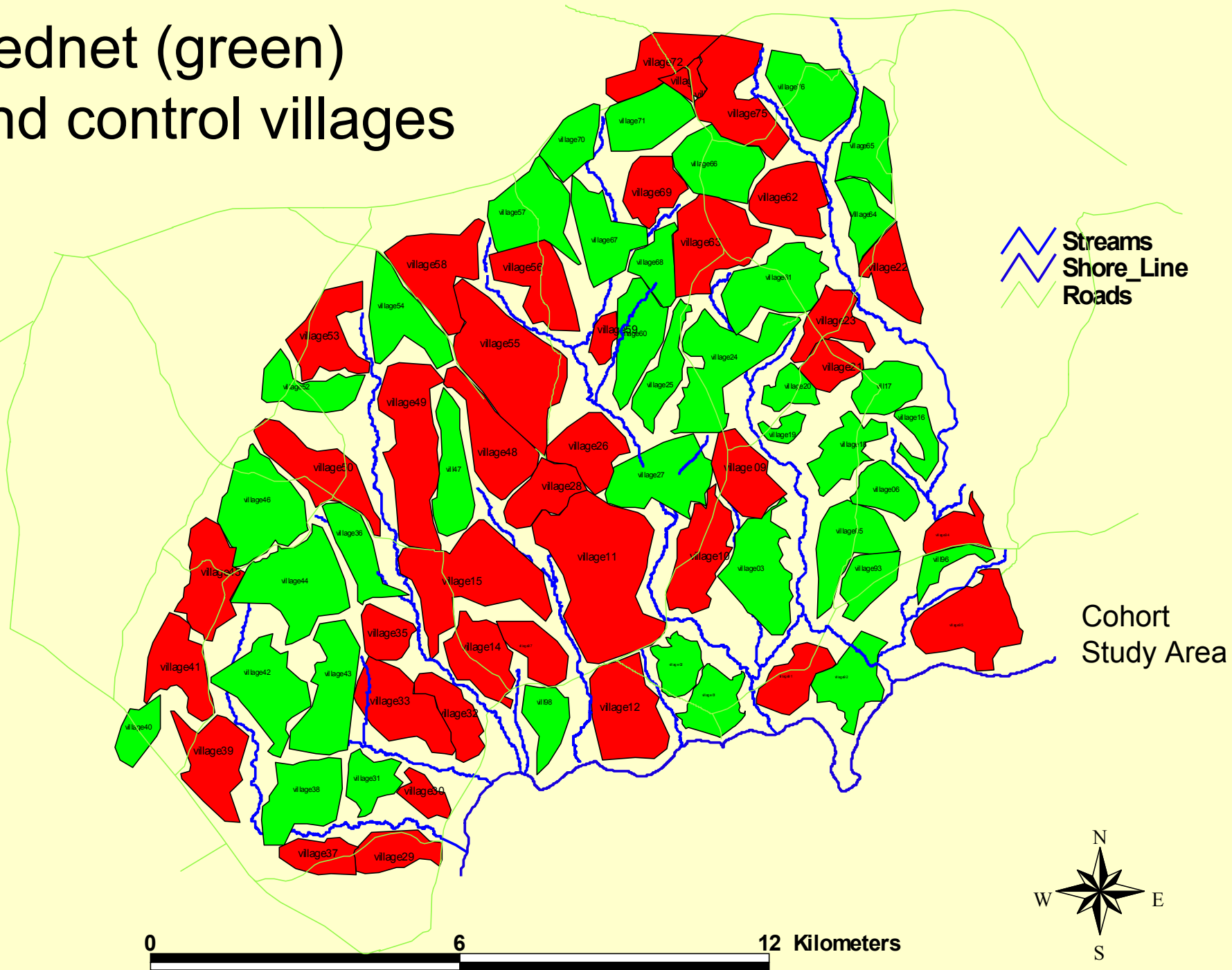
Why another study?—results from the 1990s:

- The Gambia—25% reduction in mortality in children aged 1-9 years.
- Ghana—17% reduction in mortality in children aged 6 months to 4 years.
- Coastal Kenya—33% reduction in mortality in children aged 1 to 4 years old.
- Burkina Faso—15% reduction in mortality in children aged 6 months to 4 years.

Why another study?

- No assessment yet in areas with intense (> 100 infective bites/person/year) transmission occurring year-round.
- Many (>100 million) Africans live in such areas.

Bednet (green) and control villages



Timeline

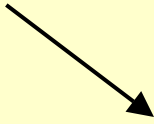
- 1996—baseline studies
- Late 1996/early 1997—nets distributed
- End of 1999—study ends.
- 2000/2001—analysis
- 2001—presentation of results to community
- 2003—formal publication of results



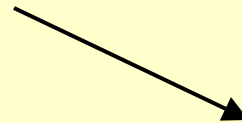




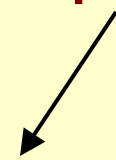
ITNs



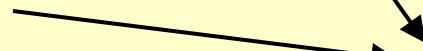
Mosquitoes



Healthier pregnancies



Healthier children



38% ↓ in parasitemia
47% ↓ in severe anemia
35% ↓ in placental malaria
28% ↓ in low birth weight

95% fewer *An gambiae*
90% reduction in transmission

74% ↓ in malaria attack rate
Median time to 1st infection 4.5 → 10.7 mos
60% ↓ incidence of severe anemia
Improved infant and child growth
27% ↓ in sick child visits to the clinic

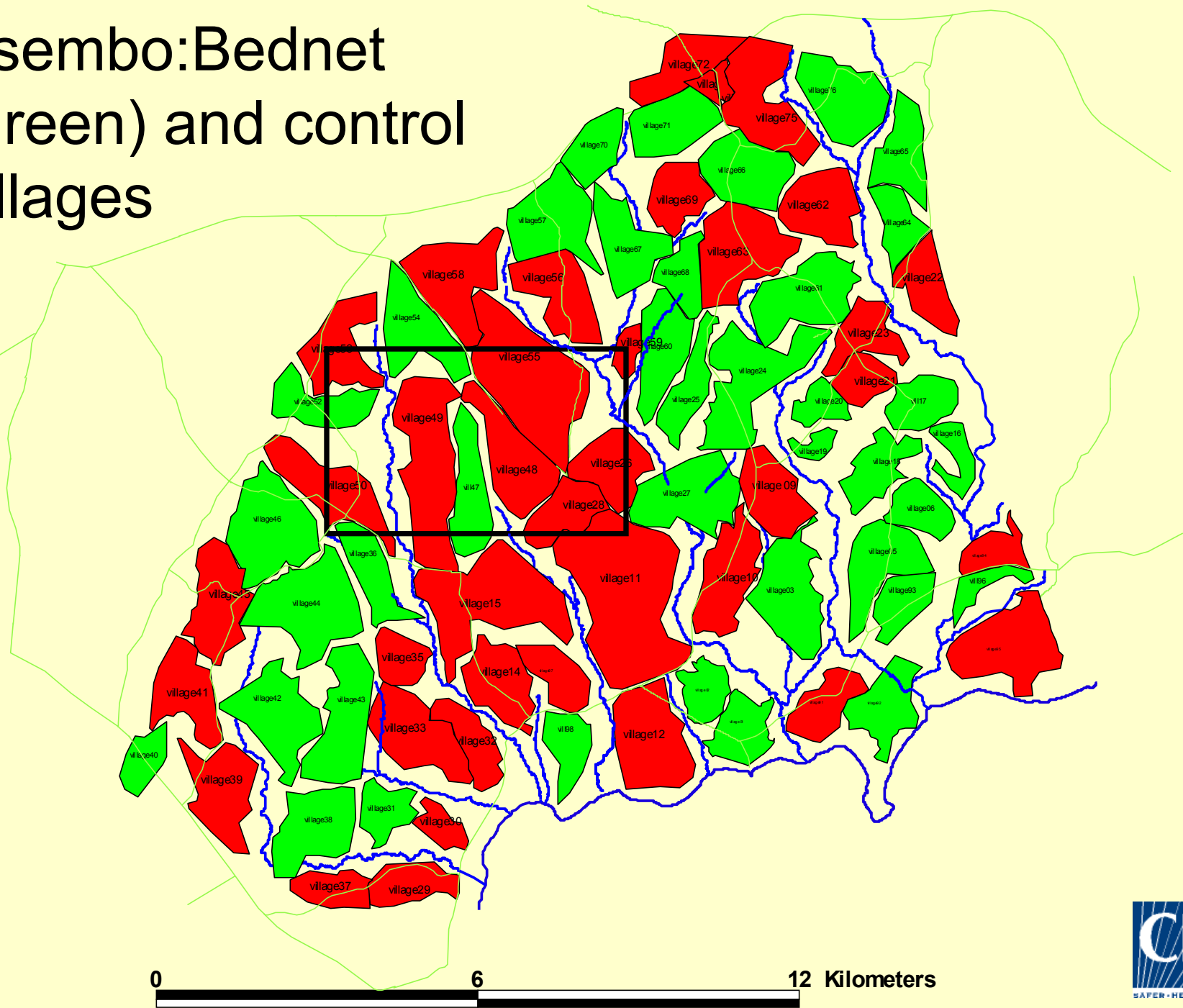
Improved infant and child survival

26% ↓ in infant mortality
14% ↓ in child (1-4yr) mortality

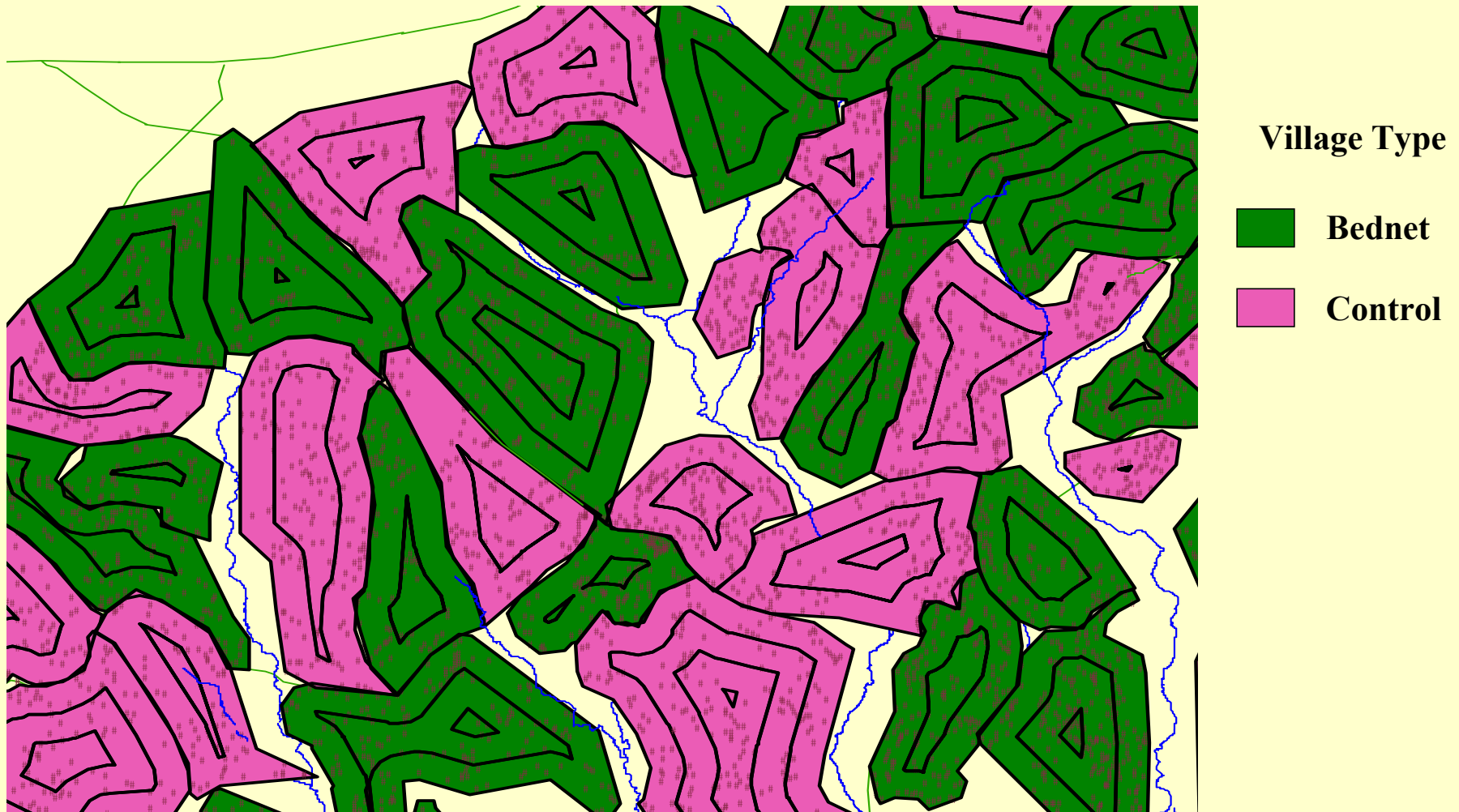
What maximizes effectiveness?

- Coverage
- Prompt insecticide retreatment
- Proper use and deployment

Asembo:Bednet (green) and control villages



By computing distances, GIS gives us the ability to see if controls living near a bednet village are better or worse off than controls living further away.



Odds Ratios for Hb < 11 by Distance

Darker Colors Mean More Protection

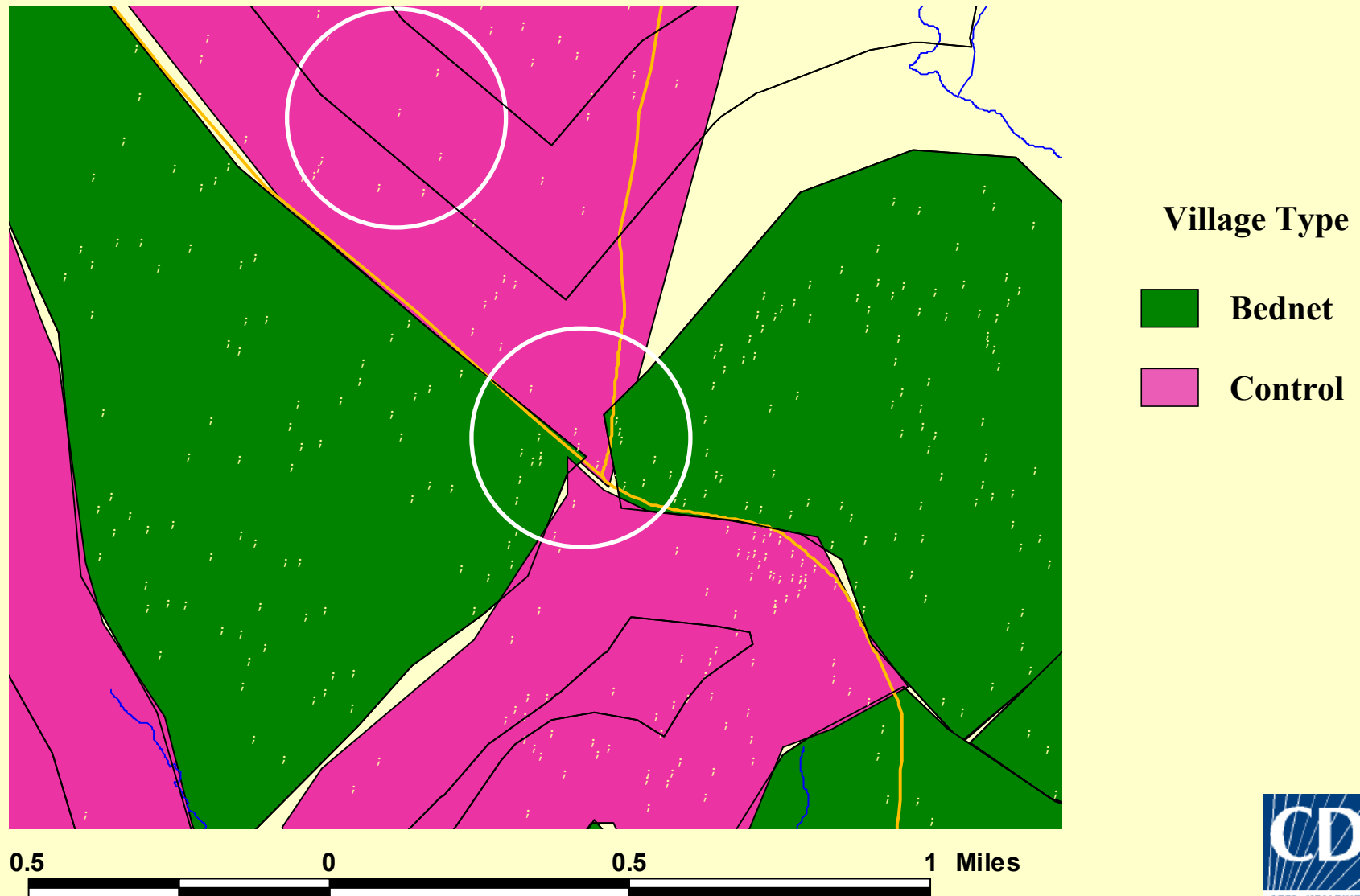
| | | <u>Distance</u> | <u>OR, 95%CI</u> |
|--------------------------|--|------------------|---------------------------|
| Control Compounds | Distance to Nearest <u>Bednet</u> Compound | >900 m | 1.0, reference |
| | | 600-900 | 1.11, (0.53, 2.33) |
| | | 300-600 | 0.70, (0.37, 1.31) |
| | | 0-300 | 0.46 (0.25, 0.85) |
| | | | |
| Bednet Compounds | Distance to Nearest <u>Control</u> Compound | 0-300 | 0.47, (0.23, 0.95) |
| | | 300-600 | 0.55, (0.29, 1.03) |
| | | 600-900 | 0.50, (0.27, 0.93) |
| | | >900 m | 0.36, (0.19, 0.69) |

Hazard Ratios for Childhood Mortality by Distance

Darker Colors Mean More Protection

| | | <u>Distance</u> | <u>HR, 95%CI</u> |
|--------------------------|--|-----------------|--------------------|
| Control Compounds | Distance to Nearest <u>Bednet</u> Compound | >900 m | 1.0, reference |
| | | 600-900 | 0.93, (0.70, 1.23) |
| | | 300-600 | 0.94, (0.72, 1.22) |
| | | 0-300 | 0.80 (0.59, 1.09) |
| | | | |
| Bednet Compounds | Distance to Nearest <u>Control</u> Compound | 0-300 | 0.81, (0.58, 1.13) |
| | | 300-600 | 0.65, (0.48, 0.87) |
| | | 600-900 | 0.69, (0.51, 0.93) |
| | | >900 m | 0.71, (0.53, 0.96) |

For each control compound, create a 300 m radius circle & compute the % of compounds with bednets. Is the benefit a function of this?



Protection from Hb < 9 as a function of % of compounds with Bednets within 300m .

Control Compounds only

| | | <u>% Coverage</u> | <u>OR, 95%CI</u> |
|-------------------|---|-------------------|--------------------|
| Control Compounds | % of Compounds with Bednets within 300m | >50% | 0.34 (0.13, 0.89) |
| | | 25 – 50% | 0.49, (0.22, 1.10) |
| | | 1 – 25% | 0.73, (0.52, 1.01) |
| | | 0% | 1.0, reference |

Delayed insecticide retreatment was associated with:

- Increased numbers of indoor-resting blood-fed malaria mosquitoes
- Increased child mortality

Failure to use ITNs was associated with:

- Increased numbers of indoor-resting blood-fed malaria mosquitoes

Maximum effectiveness requires:

- High coverage
- Prompt insecticide retreatment
- Consistent deployment of nets

Coverage is fundamental

- ITNs are as cost-effective as publicly-funded childhood vaccines.
- Once coverage is high, programs targeting retreatment and adherence are more easily carried out.

The payoff

- We estimate that over the course of our small project, 155 children are alive today who would otherwise have died.
- If ITNs were deployed today in all of malarious sub-Saharan Africa, we estimate that approximately 400,000 lives would be saved annually.





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Reading

- Summary: Hawley et al., pp 168-173
- Child mortality: Phillips-Howard et al., pp 23-29
- Pregnancy: ter Kuile et al., pp 50-60
- Child health: ter Kuile et al. pp 68-77
- Coverage effects: Hawley et al., pp 121-127
- Cost-effectiveness: Wiseman et al., pp 161-167

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